

APPENDIX 1

Public and Peer Review Panel Comments

Appendix 1-3
Authors Responses to Comments

Appendix 1-3f
Author's Response to Comments on Chapter 6

Chapter 6: Optimization Research for the Stormwater Treatment Areas

Response to Public and Peer Review Comments

By Martha K. Nungesser, Jana Majer Newman, Christy Combs, Tammy Lynch, Michael J. Chimney, and Richard Meeker

STA-1W performance

- Peer Review Panel Comments

Comment: The need for the biological and hydraulic data is acute. . . . It is highly recommended that hydraulic studies of the other STA Cells and the ENRP Test Cells be conducted.

Response: Hydraulic studies of the test cells are being conducted this year. Results of these dye studies will be reported in next year's Consolidated Report. Intensive dye studies of the Treatment Cells are prohibitive because of their large size and complexity. However, we will complete the followup dye study in Treatment Cell 4 and will pursue hydraulic studies in other Treatment Cells as feasible.

Comment: Please include more details about the dye study

Response: The full report is included in **Appendix A8-1**.

Comment: How much do HLR and depth vary from design conditions in operating STAs?

Response: The STAs operate within the design envelope, but the percent excursions from the means have not been calculated.

Comment: A plot of influent phosphorus concentration versus the effluent concentration would be useful, even if not conclusive. . . . Were the influent concentrations of phosphorus to each Cell equivalent? Was there a relationship between the performance of Cells and the influent concentrations of phosphorus?

Response: These concentrations have been included as Figure 6-2. The cells were loaded differently depending on where they were in the treatment train (Cells 3 and 4 inflow TP concentrations were lower than Cell 2). The plots show flow-weighted inflow and outflow concentrations by month for the three treatment cells (2, 3, and 4).

Comment: Chemical precipitation of phosphorus could be a significant mechanism in the STAs. . . . Have attempts been made to determine the influence of chemical precipitation?

Response: These issues are being addressed in research on submerged aquatic vegetation and periphyton.

Comment: Did Treatment Cell 3 retain less TP because it was less efficient or because it received a lower TP load?

Response: The TP load into Treatment Cell 3 was lower and accounts for at least part of the lower retention rates.

Comment: Can the variability in TP retention rates for treatment wetlands in STA-1W be related to other factors (e.g., vegetation, precipitation, etc.)?

Response: Precipitation accounts for only 1% of the TP load so it is not likely to play a major role. Factors such as vegetation type, hydraulic loading rate, depth, and area appear to play significant roles, but we are conducting further research to identify their relative importance.

Comment: An understanding of the factors controlling the limiting treatment concentration, C^* , is of crucial importance in management of STAs, future wetland STA design, and technology selection for future STAs . . .

Response: A number of researchers are attempting to determine the value of C^* for the treatment cells for STA-1W.

Comment: Discerning open water from SAV is necessary to optimize STA performance.

Response: We concur that this distinction is desirable. The sizes of the STA Treatment Cells prohibit the necessary ground surveys, and the aerial technology that we have investigated is limited in its ability to discern open water and SAV. We have used black and white photography, color photography, high contrast infrared photography and are currently investigating additional means of determining the SAV coverage and densities to better characterize these communities.

Comment: Vegetation in Cell 2 has shifted from cattails to open water/SAV in the last few years, but TP retention does not appear to have changed substantially. Is performance of this cell independent of vegetation type? If so, how do we reconcile this with the apparent performance of SAV-dominated Cell 4?

Response: Community types have shifted over time in the Treatment Cells. It appears that as one community constricts, others expand and compensate. We are attempting to determine the primary causes of ecosystem performance, including the role of vegetation. Until we know more, we cannot state with certainty the exact determinants of cell performance.

Comment: Conclusions that the performance of Cell 4 is increasing over time seem premature.

Response: The wording in the conclusions has been revised.

- **Department of Interior Comments**

Comment: It is suggested that this discrepancy [of TP in the mass balance] results from an underestimation of TP concentration associated with groundwater loading into the final stage of the eastern flow-way, cell 3. . . . At a minimum, it is recommended that a more realistic pore water TP concentration be used in Table 6-1.

Response: We will examine the values for TP in the pore water for future nutrient budgets. We are revising our seepage estimates using more recently available information and will recalculate them.

Comment: It is strongly suggested that, in addition to the phosphorus budget, a mass balance should be presented for one or more conservative constituents. . . . At a minimum, a budget for one conservative should be added to this and all future reports.

Response: The budgets will be redone to reflect the new hydrologic flow and to incorporate new information on seepage and groundwater quality. At this time, additional mass balances will be considered. Previous unpublished budgets have been developed using conservative constituents and have agreed with overall ENRP budgets.

Comment: In general, the methods used to develop Table 6-3 are inadequately documented.

Response: The description of methods has been expanded in the text to better explain the analysis.

Comment: The report uses the terminology “three-month rolling average” on page 6-10, and “3-month moving unit-area values” in Table 6-3. These terms should be defined, and any differences explained.

Response: The unit-area value is a measure of the loading per unit area of the wetland, and the 3-month moving unit-area value is the 3-month average for the wetland. The methodology has been expanded in the chapter to clarify these definitions.

Comment: Why were averages used in the statistical analysis?

Response: The three-month moving averages accommodate the variability in the nominal hydraulic residence time in the four treatment cells.

Comment: Should the degrees of freedom in the analysis of covariance be reduced to account for the use of averaging?

Response: Yes. However, changing the degrees of freedom would not significantly affect the results.

Comment: Why is N=46 rather than 48 (number of months in period from May 1995 to April 1999)? Is this caused by the use of 3-month averages?

Response: Yes.

Comment: Was the change in TP storage in the water column over the calculation interval included in the calculation of retained TP? If not, is this significant?

Response: Storage in these shallow wetlands remains relatively constant and represents a very small portion of the water budget. Therefore, the TP storage in the water column is not a significant portion of the retained TP and so was not included in the calculation of retained TP.

Test Cells

- **Peer Review Panel**

Comment: It is important that the hydraulic characteristics of the Test Cells be determined.

Response: Lithium tracer studies are being completed for 5 of the Optimization test cells covering a variety of hydraulic loading rates. Results will be reported in next year's Consolidated Report.

Comment: Was diurnal sampling of the pH value done, or was the pH value measured during the collection of samples?

Response: A YSI Hydrolab is collecting data on pH, DO, and temperature 24 hours a day at the inflow water source and at each outflow point of the test cells. Analyses of these data is ongoing and will be included in next year's Consolidated Report.

Comment: One very interesting result from the Test Cells experiments is the performance of the South Test Cell when receiving a TP input of approximately 0.030 mg/L and putting out the same concentration. This indicates that the minimum TP concentration from a wetland probably is limited to this value.

Response: The results from the south test cell HLR experiment were from only one experiment, so these levels may not be duplicated by subsequent experiments. The test cells were vegetated predominantly by a dense cover of *Typha* species. It appears that these *Typha* dominated peat-based test cells may be operating near phosphorus background concentration levels.

Comment: At the south site only the low HLR cell had a positive TP mass retention. Given that the low HLR is considerably less than average design conditions, does this suggest the south part of the STAs are superfluous?

Response: Only one of the three HLR experiments have been completed for the south test cells, so conclusions drawn from these results about design and long-term operational parameters are premature. However, there may be a lower limit to the P removal capabilities of a *Typha*-peat based wetland.

Comment: Does TP in the outflow of the south cells equal TP generated within the cells?

Response: The south test cells were operated for less than a year at the time of this report. This question cannot be answered until a mass balance is performed after one year of operation.

Comment: What was the vegetation in the ENRP test cells? Was it similar in each? . . . Did vegetation affect cell performance?

Response: Vegetation communities in each test cell are similar and are dominated by dense stands of cattails (*Typha* spp.) with a small amount of SAV (submerged aquatic vegetation) and

periphyton as well as other plants. These differences are not believed to cause different responses.

Comment: Are periphyton and macroinvertebrates experiments conducted in the Test Cells as well as the STAs?

Response: Macroinvertebrate and periphyton studies were conducted only in the test cells. Results will be reported in next year's Consolidated Report.

Comment: Sampling time has a profound impact on results obtained in biological systems . . . mention might be made of the sampling frequency, time of day . . . , and weather conditions along with a brief explanation of the difficulties of sampling such complex systems as the STAs.

Response: Sampling frequencies for the test cells were weekly or biweekly between 9:00 a.m. and 4:00 p.m. starting September 1998 at the north test cells and November 1998 at the south test cells. Previous research on diurnal patterns in TP showed no clear changes in TP water concentrations.

Comment: The methodology for the decomposition studies is not completely clear. Why was a single thread removed, and what was done with it? Was the tensile strength determined on the section of strip, or was the thread used?

Response: The methodology has been clarified in the text. Removal of single threads assures that tensile strength results were not biased by weak or torn thread edges. The threads were removed and discarded until the strips had continuous edges.

Comment: Table 6-5 should also report TN. This will facilitate comparison with TP values.

Response: TN is comprised of TKN plus nitrate/nitrite, and nitrate/nitrite represents a negligible portion of the TN, as evidenced from Fig. 6-7. Mean nitrate/nitrite values have been added to Table 6-6.

Comment: It is suggested that HLR be added as a row for each Exp in Table 6-5.

Response: The HLR experiments were not yet completed and preliminary analysis did not indicate a strong trend. Therefore the lowest HLR and highest HLR were lumped in an attempt to distinguish any major tendencies.

Comment: Figures 6-4, 6-5, 6-6, and 6-7 should plot concentration, percent, or mass versus 1/HLR. . . .

Response: The authors agree that plotting the concentration as a function of the reciprocal is a common approach used in analyzing concentration data. This function of this report was to report the status of an ongoing research project; complete analyses of the data will be reported when the HLR experiments have concluded.

Comment: A mass balance should be routinely performed on the test cell data for one or more conservative constituents . . . which, assuming the mass budget is reasonably balanced, will greatly increase the credibility of your findings.

Response: Chloride concentrations have been measured. A mass balance analysis of conservative constituents in the test cells will be performed and reported in the next Consolidated Report.

Comment: The first sentence on page 6-24 is unclear: “Higher inflow loading rates resulted in more phosphorus mass exported from the test cells than from wetlands with lower loading rates.” Does this refer to mass or hydraulic loading? What wetlands are being compared, test cells, STA cells, or natural wetlands in general?

Response: The first sentence has been changed to clarify that HLRs were increased.

Comment: The caption of Figure 6-9 refers to inflow concentration but the axis label is TP outflow concentration. Which is correct? Why is a similar plot for south test cells not presented?

Response: The correct right axis label for Fig. 6-10 is “TP inflow concentration” and the figure has been corrected. A similar graph for the south site was not presented because the experiment has not been completed.

Comment: The term “operational response” in paragraph 3 of page 6-24 is vague and not defined. The specific meaning implied here should be defined.

Response: The term operational response was meant to reflect HLRs effect on treatment processes. The sentence has been clarified to read “The north and south sites differed not only in inflow TP concentration but also in how the wetland system responded to changes in HLR.”

Marsh Dry-Out Experiments

- **Peer Review Panel**

Comment: How was water added to the test cells after dry out?

Response: Water was added quickly over 4 hours to simulate a slow rehydration, then held for a week without circulation or release. We have added this explanation to the text.

Comment: The [Marsh Dry-Out] results suggest that dryout should be avoided at all costs. Have you considered the short- and long-term impacts to downstream systems if dryout cannot be avoided?

Response: At this time we do not know what the downstream impacts would be. Most of the downstream impacts from elevated phosphorus loadings result from chronic, long-term high levels of P from inflow. We do not expect to see noticeable impacts from short-term, time-limited inflows of these relatively low levels of P seen in the Marsh Dryout Study.

Comment: The cotton strip methodologies are not completely clear.

Response: The two methodologies were clarified in the text. There are two sets of cotton strip experiments. One used frames pressed into the soils extending into the water column. The other used floating frames with the cotton strips extending downwards into the water column. After initial analyses were conducted, it was apparent that the decay potentials did not differ through the water column nor the soil column, so all results for these two media were averaged.

General Issues

- **Peer Review Panel**

Comment: Various editing issues were pointed out by reviewers, such as figure numbers, values in the text, incomplete figure headings, and unclear wording.

Response: The sentences have been corrected in the text.

Comment: More detail on the future research activities would be helpful.

Response: We have added more information on the upcoming year's research on STA Optimization to the end of Chapter 6.

Comment: The sentence (page 6-13): "We designed experiments to determine boundary conditions and system response of experimental cells at the north and south sites" is unclear. What are the boundary conditions?

Response: We have reworded this sentence to clarify that boundary conditions are those that cause failure of the wetland to process nutrients. They are expected to be at very high and very low loading rates.

Comment: The sentence (page 6-13): "Concurrently, the HLR in the remaining north and south test cells are being incrementally increased by 50 percent, decreasing hydraulic residence time, every 15 weeks to approximately 20 cm/d (high HLR experiments) (Table 6-4)." is awkward and might be rewritten.

Response: The sentence has been revised.

Comment: It is suggested that the table [6-1] be split into separate tables for the water budget and phosphorus budgets.

Response: Demarcation between the two tables has been increased.

Comment: Page 6-23, paragraph 1: Should -1.29 be -15.87?

Response: Yes. This number has been corrected in the text.